XIV. THE INDIAN BARNACLES OF THE SUBGENUS *SCALPELLUM*.

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In a former paper [1] I have discussed the subdivision of the genus *Scalpellum* and reviewed the indigenous species assigned to the subgenus *Smilium*. At present I propose to consider the remaining Indian species of the genus, that is to say those which fall into Hoek's [2] divisions *Arcoscalpellum* and *Mesoscalpellum* or into the subgenera recognized by Pilsbry [3] under the names *Arcoscalpellum* and *Scalpellum*. It seems to me unnecessary to assign to these species more than subgeneric rank and I therefore include all under the common designation *Scalpellum* (*s.s.*) or subgenus *Scalpellum*.

To this subgenus 12 Indian species are here attributed, one of them not having as yet been described. This and three others are only known from the seas of British India; four are known from the Malay Archipelago (one of them also from the western part of the Indian Ocean) and one from the Mid-Pacific; one is found in the deeper parts of the western Pacific and the southern Atlantic as well as those of the Indian Ocean; one is identical with a species described from the northern Atlantic off the American coast, and one has an extended distribution in both the Atlantic and the Indian Oceans. All are deep-sea forms only found, at any rate in tropical waters, at depths greater than one hundred fathoms. It is possible that the *Scalpellum*-fauna of the seas of British India will ultimately be proved capable of division into three geographical groups, of which one has a very restricted range, one is distributed in the deeper parts of the Indian and the western Pacific Oceans, while the third is scattered in the Indian and Atlantic Oceans at great or considerable depths. Most of the species are, however, as yet known from but few specimens and it is therefore not surprising that the distribution often seems to be extraordinarily discontinuous. This fact also makes it impossible to be dogmatic as regards specific limits, for variation is great in some species that are well known.

The following list gives the names of the species as yet recorded from the Bay of Bengal and the Arabian Sea, and also a general statement as to the known range of each :—

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1 *Rec. Ind. Mus.* V, p. 145, 1910.
2 *Siboga-Exped.*, Mon. XXXI*a*, p. 58, 1907.
3 *Proc. Acad. Nat. Sci. Philadelphia*, p. 104, 1908.

1. *Scalpellum alcockianum*, Annandale.
   Off Ceylon: 859—880 fathoms.
2. *S. velutinum*, Hoek.
   Indian and Atlantic Oceans: 35 to over 1200 fathoms.
3. *S. trapezoideum*, Hoek.
   Off Ceylon and in the Malay Archipelago: 590 to 1508 fathoms.
4. *S. pacificum*, Pilsbry.
   Arabian Sea and seas of Hawaii: 222 to 1299 fathoms.
5. *S. novae-zelandiae*, Hoek.
   Pacific, Indian and Atlantic Oceans: 490 to 1520 fathoms.
6. *S. woodmasoni*, Annandale.
   Arabian Sea: 890 fathoms.
7. *S. albatrossianum*, Pilsbry.
   N. Atlantic and B. of Bengal: 1997 and 2045 fathoms.
8. *S. gruvelii*, Annandale.
   Indian Ocean: 434 to 1200 fathoms.
9. *S. curiosum*, Hoek.
   Off C. Comorin and in the Malay Archipelago: 269 to 595 fathoms.
10. *S. lambda*, Annandale.
    B. of Bengal: 643 fathoms.
11. *S. longius*, sp. nov.
    Off Andaman Is.: 130—250 fathoms.
12. *S. laccadivicum*, Annandale.
    Arabian and Laccadive Seas and in the Malay Archipelago: 434 to 1154 fathoms.

KEY TO THE INDIAN SPECIES OF *SCALPELLUM* (*S.S.*).

I. Umbo of carina apical; the whole valve simply arched.
  A. Capitulum with paired valves relatively small (though almost complete), widely separated and almost entirely concealed by an opaque membrane; margins of tergum not excavated .. *S. alcockianum*, p. 229.
  B. Paired valves relatively large, always in contact or almost so at certain points; membrane never opaque
    1. Carinal latera meeting behind *below* the base of the carina.
      a. Carinal latera very prominent, projecting outwards as well as backwards; valves of lower whorl imbricate .. .. *S. velutinum*, p. 229.
      b. Carinal latera moderately prominent, projecting backwards but not outwards; all valves adjacent .. .. .. *S. trapezoideum*, p. 230.
    2. Carinal latera meeting behind *over* the base of the carina.
      a. Posterior basal part of carinal latera with strong radiating ridges .. *S. pacificum*, p. 230.
      b. Posterior basal part of carinal latera smooth *S. novae-zelandiae*, p. 231.

II. Umbo of carina forming a distinct projection on the dorsum of the valve, never apical.
  A. Valves stout, complete, conspicuously striated.
    1. Inframedian latus pointed above, moniliform .. *S. woodmasoni*, p. 232

2. Inframedian latus truncated above, not moniliform .. .. *S. albatrossianum*, p. 232.

B. Valves delicate, almost smooth, often incomplete.

1. Umbo of carina widely separated from apex of valve.

a. Carinal latera projecting far beyond dorsum of carina .. .. .. *S. gruvelii*, p. 232.

b. Carinal latera barely projecting beyond dorsum of carina .. .. .. *S. curiosum*, p. 233.

2. Umbo of carina subapical.

a. Occludent latus much wider than high at its inner end .. .. .. *S. laccadivicum*, p. 235.

b. Occludent latus as high as wide in lateral view.

α. Posterior basal part of carinal latera smooth, meeting *over* base of carina .. *S. lambda*, p. 234.

β. Posterior basal part of carinal latera irregularly corrugated, meeting *below* base of carina .. .. .. *S. longius*, p. 234.

1. Scalpellum alcockianum, Annandale.

Ann. Mag. Nat. Hist. (7) XVII, p. 392 (1906); *Ill. Zool. 'Investigator'*, Crust. Ent., pl. I, fig. 2; pl. II, figs. 2, 2a, 2b (1907).

In my original description of this species I failed to notice the rostrum, which is concealed by the membrane and by the band-like rostral latera. It is a small transverse hexagonal plate pointed at either end and with the upper and lower margins elongate and parallel. The labrum is prominent and bullate.

The types are from 'Investigator' station 277 to the S. of Ceylon: 5°48′15″ N., 80°56′ E.; 859 to 880 fathoms.

S. alcockianum is related to the N. Atlantic *S. giganteum*, Gruvel, several of the peculiar features of which it possesses in an exaggerated degree. Varieties may be expected to occur in which the valves occupy a much greater part of the capitular area than in the typical form, if we may judge from the analogy of *S. stearnsi* Pilsbry, a somewhat similar Malaysian species. The great length of the anal appendages is a noteworthy character, but the exact length and the number of segments of these structures is variable within wide limits.

Type No. $^{2\,9\,+\,3}_{1\,0}$ Crust. Ind. Mus.

2. Scalpellum velutinum, Hoek.

Scalpellum velutinum, Hoek. *'Challenger' Zool. Rep.* VIII (Cirripedia), p. 96, pls. IV, figs. 10, 11, and IX, figs. 7, 8, 9 (1883); Pilsbry, *U. S. Nat. Mus. Bull.* 60, p. 26, pl. III, figs. 2, 3 (1907); Annandale, *Ill. Zool. 'Investigator,'* Crust. Ent., pl. IV, fig. 7 (1908); *Ann. Mag. Nat. Hist.* (8) VII, p. 588 (1911).

Scalpellum eximium, Hoek, *op. cit.*, p. 100, pls. IV, figs. 6, 7, and IX, figs. 10, 10* (1883).

Scalpellum sordidum, Aurivillius, *Bull. Soc. Zool. France* XXIII, p. 190 (1898).

Scalpellum alatum, Gruvel, *Rep.* '*Travailleur*' *et* '*Talisman*,' Cirrhipèdes, p. 57 (1902).

Specimens from 'Investigator' station 232: 7°17′30″ N., 76° 54′30″ E. (430 fathoms) and others from Indian seas labelled simply "deep sea" agree in every respect with examples from off the south-west of Ireland that I have recently examined.

The spines on the degenerate male (see Hoek's fig. 10* on plate IX in the first part of his 'Challenger' report) have a very characteristic form, but the whole specimen of that sex figured under the name *S. eximium* on the same plate was certainly distorted.

S. velutinum is one of the most widely distributed of the deep-sea Cirripedia. It occurs on both sides of the N. Atlantic and off Tristan d'Acunha; there are specimens in the British Museum taken from a cable lying in 1200 fathoms in Lat. 12°20′ N., Long. 52°30′ E.

The bathymetric range is from 35 to over 1200 fathoms. As Pilsbry points out, the species is closely related to *S. formae*, Alessandri, of the Italian Miocene.

Type in the British Museum.

3. Scalpellum trapezoideum, Hoek.

Scalpellum trapezoideum, Hoek, *Siboga-Expeditie*, Mon. XXXIa (Cirripedia Pedunculata), p. 102, pl. VIII, fig. 6 (1907); Annandale, *Ill. Zool.* '*Investigator*,' Crust. Ent., pl. IV, fig. 9 (1908).

?Scalpellum truncatum, Annandale in Herdman's *Pearl Oyster Fisheries* (Roy. Soc. Lond.), part V, Suppl. XXXI, p. 142 (1906).

A specimen, dredged by the 'Investigator' at station 317 from 590 fathoms in the Gulf of Manaar (7°4′ N., 79°32′ E.) agrees with Hoek's description and figures. It was identified by me as (*?*) *Scalpellum truncatum*, Hoek, in Professor Herdman's report on the Ceylon Pearl Fisheries, but clearly belongs to the species to which it is assigned in the 'Investigator' Illustrations. It is attached to a piece of coal.

The species was originally described from Lat. 6°30′ S., Long. 12°55′ E. and from a depth of 2796 m. (=1508 fathoms).

Type in the Amsterdam Museum.

4. Scalpellum pacificum, Pilsbry.

Scalpellum pacificum, Pilsbry, *Bull. Bur. Fish. U.S.A.* No. 617, p. 182, pl. IV, figs. 3, 4 (1907).

Scalpellum tenue, Annandale (*nec* Hoek), *Herdman's Pearl Oyster Fisheries*, V, p. 142 (1906).

Cirri colourless, moderate. The anterior ramus of the first cirrus flattened and expanded, especially in the 4th, 5th, and 6th segments; the last (9th) segment much narrower than the others,

bearing numerous stout bristles; posterior ramus slender, slightly longer than anterior ramus.

Mouth-parts moderate. Mandible wide, with four subequal teeth of moderate size; the first widely separated from the others; the fourth (inner angle) pointed. The second maxilla moderately wide; its cutting edge nearly straight but bearing a very narrow incisure separated from the outer edge by three large and one small bristle; the stoutest of these bristles not much larger than those on the edge within the incisure.

Anal cirri short, cylindrical, slender, with 5 segments, of which the basal (1st) is much the longest; 2nd and 5th segments subequal, shorter than 3rd and 4th; four long subequal bristles at apex; one long and one moderate bristle at apex of 4th segment posteriorly; at least two shorter bristles in same position on the 3rd segment.

Penis absent.

Type in the U.S. Nat. Mus.

Distribution. 'Investigator' stations 299 and 268: Arabian Sea, 23°43′ N., 58°51′30″ E.; 1299 fathoms, and south of Cape Comorin, 7°36′ N., 78°5′ E″.; 556—589 fathoms; Hawaiian seas; 315 and 222 to 498 fathoms ('Albatross').

S. pacificum is allied to *S. novae-zelandiae*, Hoek, from which it may be distinguished by its stouter and more closely set valves, by the greater breadth of the rostral latus and especially by the formation of the posterior basal part of the carinal latera. Its closest ally, however, is probably *S. albatrossianum*, Pilsbry, although the two species fall technically into different subdivisions of the subgenus in the system here provisionally adopted.

5. Scalpellum novae-zelandiae, Hoek.

Hoek, '*Challenger*' *Zool. Rep.* VIII (Cirripedia), p. 124, pl. V, figs. 7, 8 (1883); Gruvel, *Rep.* '*Travailleur*' *et* '*Talisman*,' Cirrhipèdes, p. 54, pl. II, figs. 12, 13, 15 (1902); Annandale, *Ill. Zool.* '*Investigator*,' Crust. Ent., pl. V, fig. 7 (1908).

Two Indian specimens are in our collection obtained by the 'Investigator', one from the Andaman Sea (490 fathoms) and one from Lat. 6°18′ N., Long. 90°40′ E. (1520 fathoms). They agree fairly well with Hoek's original figure, but vary in certain characters, notably in the exact form of the valves of the lower whorl. In one the inframedian latus is shaped like an hourglass; and in the other it is barely constricted at all.

Scalpellum novae-zelandiae was originally obtained off New Zealand by the 'Challenger' in 700 fathoms. The 'Travailleur' took three specimens in Lat. 38°8′ N., Long. 12°3′ E. in between 1314 and 1370 fathoms. The species, everywhere scarce, has thus an even wider known range than *S. velutinum*, occurring in the Pacific, Indian and Atlantic Oceans.

Type in the British Museum.

6. **Scalpellum woodmasoni**, Annandale.

Ann. Mag. Nat. Hist. (7) XVII, p. 39 (1906); *Ill. Zool.* '*Investigator*,' Crust. Ent., pl. I, fig. 7 (1907).

Only the type-specimen is known. It is from 'Investigator' station 183 in the Arabian Sea: Lat. 23°8′22″ N., Long. 65° 49′45″ E.; 890 fathoms.

Type No. $\frac{124}{10}$ Crust. Ind. Mus.

7. **Scalpellum albatrossianum**, Pilsbry.

Pilsbry, *U. S. Nat. Mus. Bull.* 60, p. 54, fig. 19 (1907); Annandale, *Ill. Zool.* '*Investigator*,' Crust. Ent., pl. III, fig. 10 (1908).

Only two specimens of this species are known; the type, which was taken in the N. Atlantic off Cape Hatteras in 2045 fathoms by the 'Albatross', and one taken by the 'Investigator' in 1997 fathoms at station 110 in the Bay of Bengal: Lat. 9°34′ N., Long. 85°43′15″ E.

So far as I can judge from Pilsbry's figure, there is hardly any difference between the specimens, but he says that the carinal umbo is apical, while I class it as subapical. In the Indian specimen this umbo, as Pilsbry says was the case with the American one, is in contact with the terga and, therefore, appears to be terminal. There is, however, a short continuation of the valve hidden between the terga. The species is closely related to *S. woodmasoni*, from which it may be distinguished by its broader scutum and hourglass-shaped inframedian latus.

The cirri and mouth-parts closely resemble those of *S. pacificum*, but the anterior ramus of the first cirrus is relatively broader, the outer tooth of the mandible is relatively larger and the two inner teeth of the appendage lie closer together. The anal appendages of the two species are also closely similar, but those of *S. albatrossianum* bear a larger bunch of bristles at the apex. In spite of the fact that *S. pacificum* falls into a different section of the sub-genus technically, I see no difficulty in believing it to be closely allied to *S. albatrossianum*.

The figure in the 'Investigator' Illustrations was prepared from the Indian specimen, before it was realised that the species was identical with the American one.

Type in the U. S. Nat. Mus.

8. **Scalpellum gruvelii**, Annandale.

Scalpellum gruvelii and var. *quadratum*, Annandale, *Ann. Mag. Nat. Hist.* (7) XVII, p. 390 (1906); *Ill. Zool.* '*Investigator*,' Crust. Ent., pl. I, fig. 1; pl. II, figs. 1, 1a and 3 (1907); Herdman's *Rep. Pearl Oyster Fisheries*, V,

p. 141, fig 4 (1906); Stewart, *Mem. Ind. Mus.* III, p. 33, pl. VII, fig 5 (male); 1911.

Scalpellum chitinosum, Hoek, *Sib.-Exp.*, Mon. XXXI*a*, p. 73, pl. VII, fig. 4 (1907).

This is a variable species, like all those in which the valves are sometimes incomplete; the "complete" form, if it exists, is unknown. Pilsbry's *S. imperfectum*[1] and *S. sanctaebarbarae*[1] are very closely allied and may be only varieties or local races. I have seen a specimen of the former. *S. chitinosum*, Hoek, is certainly identical. The exact position of the carinal umbo is one of the variable characters.

Stewart (*op. cit. supra*) has given a detailed and excellent account of the male and of the later development of both sexes.

Scalpellum gruvelii has been taken by the 'Investigator' at the following stations:—

Sta. 249: Laccadive Sea, 7° N., 76°36′15″ E.; 1022 fathoms (Types).
,, 276: Laccadive Sea, 7°11′ N., 76°35′30″ E.; 1006 fathoms.
,, 277: S. of Ceylon, 5°48′15″ N., 80°56′ E.; 859—880 fathoms.
" 306: Laccadive Sea, 9°20′ N., 75°24′ E.; 930 fathoms.

There are specimens in the British Museum from a cable laid at 1200 fathoms in the Indian Ocean in Lat. 14°20′ N., Long. 52° 30′ E. They were accompanied by *Scalpellum velutinum* and *S.* (*Smilium*) *acutum*, Hoek. *S. chitinosum* was taken off Sumbawa and the Kei Is. in the Malay Archipelago in 794 and 1788 m. (=434 and 977 fathoms). *S. imperfectum* is from the N. Atlantic and *S. sanctaebarbarae* from off the coast of California. The type of the former was attached to a specimen of *S. velutinum*. It was taken in 781 fathoms and others of the same form were taken in 852 and 1230 fathoms. *S. sanctaebarbarae* was dredged from 414 and 603 fathoms.

Type No. $\frac{3^{3}33}{10}$ Crust. Ind. Mus.

9. Scalpellum curiosum, Hoek.

Scalpellum curiosum, Hoek, *Sib.-Exp.*, Mon. XXXI*a*, p. 79, pl. VII, figs. 8, 8a, 8b (1907); Annandale, *Ill. Zool.* '*Investigator*,' Crust. Ent., pl. IV, fig. 8 (1908);

Scalpellum japonicum, *id.* (*nec* Hoek), Herdman's *Pearl Oyster Fisheries*, V, p. 141 (1906).

A specimen dredged by the 'Investigator' at station 268 (S. of Cape Comorin, Lat. 7°36′ N., Long. 78°5′ E.) in between 556

[1] *U. S. Nat. Mus. Bull.* 60, pp. 75 and 77, figs. 30 and 31 (1907).

and 595 fathoms, only differs from Hoek's figure in having the capitulum a little broader, the carina more strongly arched, the valves of the lower whorl more incomplete and the peduncular plates broader. In these "incomplete" species great variation must be expected, and without further material I hesitate to regard the Indian form as distinct.

Type in the Amsterdam Museum.

10. Scalpellum lambda, Annandale.

Rec. Ind. Mus. V, p. 115 (1910).

Type No. $\frac{5633}{10}$ Crust. Ind. Mus., from 'Investigator' station 372: 13°54′15″ N., 94°2′15″ E.; 643 fathoms.

11. Scalpellum longius, sp. nov.

Capitulum narrowly ovoid, more than twice as high as broad, bearing 13 (or 14) thin, smooth, translucent white valves, which cover its surface almost completely; external membrane thin, colourless, transparent, smooth.

Carina regularly and moderately curved; umbo subapical; sides moderately broad, distinctly concave; dorsum concave, with well-defined lateral borders; apex of valve far removed from apex of capitulum.

Tergum very large, triangular, extending for about $\frac{1}{3}$ of its length above the apex of the carina, sharply pointed and somewhat retroverted at the upper end; occludent margin convex; lower margin straight, sloping upwards and outwards from the carina; carinal margin straight, much the longest of the three, sloping upwards and outwards along the carina, with a distinct tooth just above the carinal apex and distinctly sinuous beyond it.

Scutum smaller than tergum, irregularly triangular; apex retroverted from occludent edge of capitulum, sharply pointed; occludent margin as a whole convex, vertical; tergal margin short, markedly concave, with a prominent tooth at either extremity; inner margin almost as long as occludent margin, very strongly sinuous.

Median (*upper*) *latus* having the form of an oblique isosceles triangle with each basal angle broadly, obliquely, equally truncated, in such a way that the whole outline is pentagonal; tergal and scutal margins equal, the latter slightly concave, the former slightly convex; carinal and lower margins equal, straight; suture with carinal latus longer than either, straight, slanting.

Carinal latus quadrilateral, high but narrow, by no means prominent behind; inner and outer margins straight, vertical subparallel; upper margin much shorter, straight, sloping downwards from carina; lower margin straight, sloping downwards from inframedian latus; posterior basal part meeting its fellow below the base of the carina and forming a short vertical suture with it, irregularly triangular, corrugated.

Inframedian latus high, moderately narrow, pointed below, angular above, where it is nearly as wide as the carinal latus.

Rostral latus triangular, pointed below at the aperture, by no means prominent.

Rostrum minute, almost entirely concealed; possibly sometimes absent.

Peduncle cylindrical, much shorter than capitulum, covered with prominent, transverse, alternating scales closely compacted.

I have dissected out the appendages of a specimen but can find no difference in them likely to be constant from those of *S. lambda*, except in the following points:—the two rami of the first cirrus are equal (possibly a variable character) and the anal appendages consist of only 6 segments instead of about 8.

The mandibles are perhaps abnormal; the three outer teeth are subequal and equidistant, but the inner angle is produced and forms a projecting portion of relatively large size and with nearly parallel but somewhat irregular edges; at its extremity it bears two teeth, of which the inner tooth is bent towards the outer one.

Type No. $\frac{5043}{10}$ Crust. Ind. Mus.

Locality. Andamans; 130—250 fathoms.

Males not observed.

Measurements:—

	Capitulum.	Peduncle.
Height	.. 8·5 mm.	1·5 mm.
Breadth	.. 4·0 ,,	1·5 ,,

Possibly *Scalpellum longius* as here described is merely a complete form of *S. lambda*, but the structure and position of the posterior basal parts of the carinal latera of the two forms are very different; in *S. lambda* these meet over the base of the carina and have the shape of regular isosceles triangles in contact for the whole of their bases, and their surface is smooth. Unless or until intermediate specimens are obtained, the two must, therefore, be regarded as specifically distinct. The greater relative height of the capitulum is quite probably an inconstant feature.

S. longius will be figured, with *S. lambda*, in an account of the Indian species of the families Scalpellidae (=Pollicipedidae, mihi, 1909 [1]) and Iblidae which is now in the course of preparation but will not be ready for publication for some little time.

12. Scalpellum laccadivicum, Annandale.

Scalpellum laccadivicum and var. *investigatoris*, Annandale, *Ann. Mag. Nat. Hist.* (7) XVII, p. 393 (1906); *Ill. Zool. 'Investigator,'* Crust. Ent., pl. I, figs. 3, 4 (1907).

Scalpellum subflavum, *id.*, *ibid.*, p. 397 (1906) and pl. I, fig. 6 (1907).

[1] "An account of the Indian Cirripedia Pedunculata, Part 1.—Family Lepadidae (*sensu stricto*)," *Mem. Ind. Mus.* II, p. 63 (1907).

Scalpellum polymorphum, Hoek, *Sib.-Exp.*, Mon. XXXI*a*, p. 80, pl. VII, figs. 9-11 (1907).

I have now no doubt that all the forms mentioned in the above synonomy represent a single very variable species, the valves of which may be practically complete, or very incomplete indeed, or exhibit various intermediate stages. Some specimens of my *S. subflavum* are identical with Hoek's figure of his *S. polymorphum* form C, while the types of *S. laccadivicum* and its variety *investigatoris* are somewhat less complete as regards the valves of the upper whorl than any of the specimens obtained by the 'Siboga.' Their capitulum is also broader, but there is considerable variation in this respect, as there is also in the length of the peduncle. My description of the appendages, drawn up at a time at which I had little experience, was incorrect in several particulars They agree well with those described by Hoek, allowance being made for the very considerable individual variation that certainly exists. The rostrum is rudimentary or absent.

Scalpellum laccadivicum has been taken by the 'Investigator' at the following stations :—

Sat. 297 : Gulf of Oman, 25°11′ 30 N., 57°15′ E. ; 689-700 fathoms.
,, 298 : Arabian Sea, 23°48′ 30″ N., 58°33′ 45″ E. ; 337-398 fathoms.
,, 317 : W. of Ceylon, 7°4′ N., 79°32′ E. ; 590 fathoms (Types).
,, 319 : Laccadive Sea, 12°2′ N., 73°46′ E. ; 1154 fathoms.
,, 358 : Arabian Sea, 15°55′ 30″ N., 52°38′ 30″ E. ; 585 fathoms.

At station 319 only the typical form and the form *investigatoris* were obtained ; at all the others, and also at an unrecorded point in the Andaman Sea (173 fathoms), only the form *subflavum*. The 'Siboga' specimens were taken off the Kei Is. and off Sumbawa in 397 m. (= 220 fathoms).

Type No. $\frac{5040}{10}$ Crust. Ind. Mus.